TOPPENISH SEWAGE TREATMENT PLANT
CLASS II INSPECTION
MAY 29-30, 1990

by
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Segment No. WA-37-1020
(Water Body No. 18-37-01)

October 1991

ABSTRACT

A Class II Inspection was conducted at the Toppenish Sewage Treatment Plant (STP) on May 29-30, 1990. The Toppenish STP is a rotating biological contactor (RBC) type secondary treatment facility. Discharge is to the Yakima River via the Toppenish Drain as regulated by NPDES Permit No. WA-002068-1. The plant appeared well maintained and well operated during the inspection. The effluent was within most permit limits. Few priority pollutants were detected in the effluent. Bioassays conducted with *Ceriodaphnia dubia*, fathead minnow, and rainbow trout indicated no effluent toxicity. Plant laboratory procedures were generally good. Receiving water samples found fecal and total coliform concentrations were greater in the Toppenish Drain than in the STP effluent.

INTRODUCTION

A Class II Inspection was conducted at the Toppenish Sewage Treatment Plant (STP) on May 29-30, 1990. Conducting the inspection were Marc Heffner of the Department of Ecology (Ecology) Toxics, Compliance, and Ground Water Investigations Section, and Polly Zehm of Ecology's Central Regional Office. Ed Martindale, the plant operator, assisted on site.

Objectives of the Inspection

1. Assess plant compliance with NPDES permit effluent limits.

2. Characterize toxicity with priority pollutant scans and effluent bioassays.

3. Review lab procedures to determine conformance with standard techniques. Samples were split with the permittee for permit parameter analysis to determine comparability of Ecology laboratory and permittee laboratory results.

4. Conduct a limited receiving water study in the Toppenish Drain focusing primarily on dissolved oxygen and nutrient concentrations.

The Toppenish STP is a rotating biological contactor (RBC) type secondary treatment facility (Figure 1). The plant flowmeter, a Sparling 500 transit time ultrasonic flowmeter, is located in the influent line upstream of the headworks. The headworks include a grit basin and a comminutor. Sewage flows from the headworks to a wet well. It is pumped from the wet well to the primary clarifier and then flows by gravity through the rest of the treatment plant. Three mechanically driven RBC trains of two shafts each provide secondary treatment. The first shaft of each train receives supplemental aeration (the aeration system for train two was not functioning during the inspection). The second shaft of trains one and two is divided by a baffle into two basins. The baffle in the second shaft of train three had been removed during maintenance and not replaced. The wastewater is chlorinated in the RBC effluent trough then flows through the secondary clarifier and chlorine contact basin. Discharge is to the Yakima River via the Toppenish Drain as regulated by NPDES Permit No. WA-002068-1.

Sludge from the secondary clarifier is combined with the influent flow upstream of the primary clarifier (Figure 1). The settled primary clarifier sludge is anaerobically digested, dried in evaporative sludge drying beds, and sent to the landfill for disposal.

METHODS

Class II Inspection sampling included Ecology grab and composite samples. Ecology Isco compositors were set up to collect influent (after the comminutor) and effluent (after the chlorine contact chamber) samples. Approximately 350 mLs of sample were collected every 30 minutes for 24 hours (10:00 a.m. to 10:00 a.m.). The compositors were iced to cool samples immediately upon collection. Ecology quality assurance procedures included cleaning the

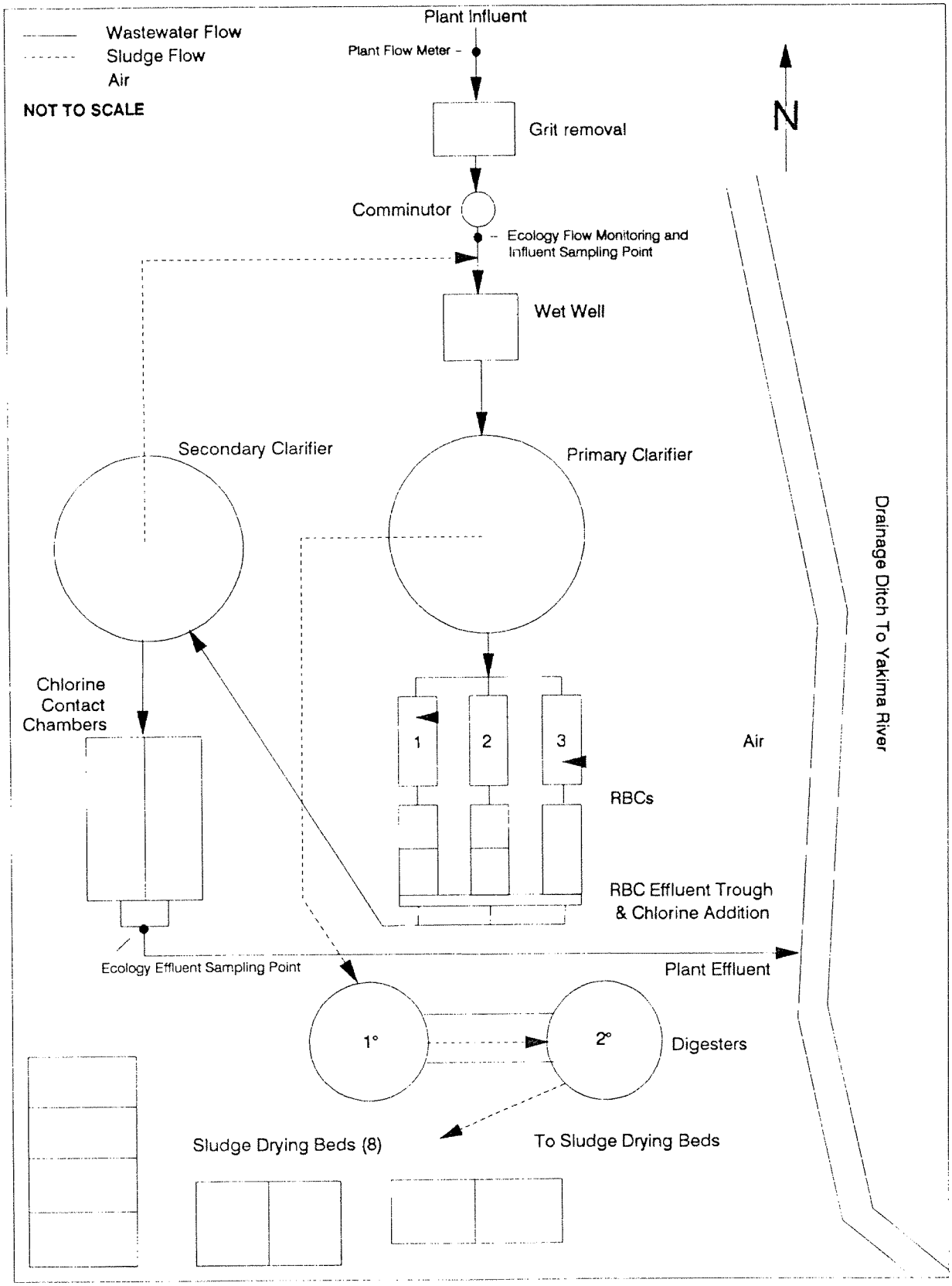


Figure 1. Plant Schematic - Toppenish Class II - May 1990

composite samplers for priority pollutant analysis prior to the inspection (Appendix A). The STP operator collected influent and effluent composite samples as well. The Toppenish influent automatic composite sampler collected hourly (09:00 a.m. to 09:00 a.m.), while the effluent composite was hand collected hourly during the 08:00 a.m. - 5:00 p.m. work day. The composite samples described above were split for analysis by the Ecology and STP laboratories. An additional effluent grab composite sample, consisting of three subsamples, was collected by Ecology for bioassay testing. Samples collected, sampling times, and parameters analyzed are summarized in Table 1.

Samples for analysis by Ecology were placed on ice and shipped to the Ecology Manchester Laboratory. Analytical methods and laboratories performing the analyses are summarized in Table 2.

Ecology set up a Marsh-McBirney Flo-Tote® flowmeter during the inspection to take measurements for comparison with the in-plant flowmeter. The meter was set up in a rectangular channel as the flow entered the plant (Figure 1).

Receiving water grab samples were taken from the Toppenish Drainage Ditch. Four drain stations, collected an arm's length from the effluent discharge side of the drain, and an effluent station, collected at the end of the discharge pipe, were sampled (Figure 2). Samples collected, sampling times, and parameters analyzed are summarized in Table 1. The STP operator measured the drain flow rate at the measurement culvert using a propeller-type current meter.

RESULTS AND DISCUSSION

Flow Measurement

The Ecology instantaneous measurements corresponded closely with the Toppenish plant meter's instantaneous measurements (Table 3).

The strip charts of the Ecology Flo-Tote® and plant meters also compare closely (Figure 3). The Ecology strip chart recorded slightly higher flow rates but this is thought to be related to rags catching on the Ecology set-up and slightly raising the water level. The Ecology instantaneous measurements on May 30 illustrate that the Ecology measurement was slightly higher until the rags were pulled off, then the two meters corresponded well (Table 3). The Toppenish flowmeter appears to have been accurate, and the reported flow of 1.19 MGD for 08:00 a.m. May 29, 1990 to 08:00 a.m. May 30, 1990 is accepted for the purposes of this report.

General Chemistry/NPDES Permit Parameters

Ammonia nitrogen (NH_3-N) decreased by 2 to 3 mg/L through the plant while nitrate+nitrite nitrogen (NO_3+NO_2-N) showed a corresponding increase (Table 4). The total phosphorus (Total-P) concentration remained essentially constant. Alkalinity appeared to decrease slightly through the plant (probably due to the nitrification of ammonia noted above).

Table 1. Sampling Schedule and Parameters Analyzed – Toppenish, May 1990.

	Sample:	Influent	Influent	Influent	Influent	Influent	Effluent	Effluent	Effluent	Effluent	Effluent	Effluent	Effluent
	Lab Log #:	228080	228081		228082	228083	228084	228085		228087	228088	228089	228090
	Sampler:	Ecology	Ecology	Ecology	Ecology	Toppenish	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Toppenish
	Date:	5/29	5/29	5/30	5/29–30	5/29–30	5/29	5/29	5/30	5/30	5/29–30	5/29–30	5/29
	Time:	1115	1620	0845	1000–1000	0900–0900	1045	1640	0850	1025	1000–1000	*	**
	Type:	Grab	Grab	Grab	Comp	Comp	Grab	Grab	Grab	Grab	Comp	Comp	Comp
Field Analysis													
Conductivity		E	E	E	E	E	E	E	E	E	E		E
pH		E	E	E	E	E	E	E	E	E	E		E
Temperature		E	E	E	E	E	E	E	E	E	E		E
Chlorine Residual													
Free							E	E	E	E			
Total							E	E	E	ET	E		
Dissolved Oxygen													
Laboratory Analysis													
Turbidity											E		E
Conductivity					E	E	E	E			E		E
Alkalinity					E	E	E	E			E		E
Hardness					E	E	E	E			E		E
Chloride					E	E	E	E			E		E
TS					E	E					E		E
TNVS					E	E					E		E
TSS					ET	ET	E	E			ET		ET
TNVSS					E	E					E		E
BOD5					ET	ET					ET		ET
Inhib. BOD5					E	E					E		E
COD					E	E	E	E			E		E
TOC (solids)													
NH3-N					E	E	E	E			E		E
NO3+NO2-N					E	E	E	E			E		E
Total-P					E	E	E	E			E		E
Fecal Coliform										E			
Total Coliform										ET			
pp metals					E						E		
BNA (water)					E						E		
VOA (water)		E	E				E	E					
Pest/PCB (water)					E						E		
% Solids													
% Volatile Solids													
Trout												E	
Microtox												E	
Fathead Minnow												E	
Ceriodaphnia dubia												E	

E Ecology laboratory analysis.
T Toppenish laboratory analysis.
* Hand composite – equal volumes collected at 1045 on 5/29, at 1640 on 5/29, and at 0850 on 5/30.
** Hand composite – equal volumes collected hourly between 0800 and 1700.
*** Collected at discharge to Drain.

Table 1. Sampling Schedule and Parameters Analyzed – Toppenish, May 1990 (continued).

	Sample:	Sludge	Drain 1	Effluent***	Drain 2	Drain 3	Drain 4
	Lab Log #:	228091	228092	228086	228093	228094	228095
	Sampler:	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
	Date:	5/30	5/30	5/30	5/30	5/30	5/30
	Time:	0905	1135	1145	1200	1220	1235
	Type:	Grab	Grab	Grab	Grab	Grab	Grab
Field Analysis							
Conductivity			E	E	E	E	E
pH			E	E	E	E	E
Temperature			E	E	E	E	E
Chlorine Residual							
Free							
Total			E	E	E	E	E
Dissolved Oxygen			E	E	E	E	E
Laboratory Analysis							
Turbidity			E	E	E	E	E
Conductivity			E	E	E	E	E
Alkalinity			E	E	E	E	E
Hardness			E	E	E	E	E
Chloride			E	E	E	E	E
TS							
TNVS							
TSS			E	E	E	E	E
TNVSS							
BOD5							
Inhib. BOD5							
COD			E	E	E	E	E
TOC (solids)		E					
NH3-N			E	E	E	E	E
NO3+NO2-N			E	E	E	E	E
Total-P			E	E	E	E	E
Fecal Coliform			E	E	E	E	E
Total Coliform			E	E	E	E	E
pp metals		E					
BNA (water)							
VOA (water)							
Pest/PCB (water)							
% Solids		E					
% Volatile Solids		E					
Trout							
Microtox							
Fathead Minnow							
Ceriodaphnia dubia							

E Ecology laboratory analysis.
T Toppenish laboratory analysis.
* Hand composite – equal volumes collected at 1045 on 5/29, at 1640 on 5/29, and at 0850 on 5/30.
** Hand composite – equal volumes collected hourly between 0800 and 1700.
*** Collected at discharge to Drain.

Table 2. Analytical Methods and Laboratories - Toppenish, May 1990.

	EPA 1983	EPA 1986	Other Methods	Laboratory
General Chemistry				
Turbidity	180.1			Manchester
Conductivity	120.1			Manchester
Alkalinity	310.1			AM Test
Hardness	130.2			Manchester
Chloride	300.0			Manchester
TSS	160.2			Manchester
TNVSS	160.4			Manchester
BOD5	405.1			Manchester
Inhib. BOD5	405.1			Manchester
COD	410.1			Manchester
TOC (solids)			Tetra Tech	AM Test
NH3-N	350.1			Manchester
NO3+NO2-N	353.2			Manchester
Total-P	365.2			Manchester
Fecal Coliform			SM-17 9222D	Manchester
Total Coliform			SM-17 9222B	Manchester
% Solids	160.3			AM Test
% Volatile Solids	160.4			AM Test
Priority Pollutants				
Metals (water)*	200 series+			AM Test
Metals (sludge)**				AM Test
Antimony		7041 (GFAA)		
Arsenic		6010 (ICP)		
Beryllium		6010 (ICP)		
Cadmium		6010 (ICP)		
Chromium		6010 (ICP)		
Copper		6010 (ICP)		
Lead		7421 (GFAA)		
Mercury		7470 (CVA)		
Nickel		6010 (ICP)		
Selenium		7740 (GFAA)		
Silver		6010 (ICP)		
Thallium		7841 (GFAA)		
Zinc		6010 (ICP)		
BNA (water)		3510/8270		Columbia Analytical
VOA (water)		8240		Columbia Analytical
Pest/PCB (water)		3510/8080		Columbia Analytical
Bioassays				
Trout			Ecology	Parametrix
Microtox			Beckman	Ecova
Fathead Minnow			EPA 1989	Northwestern Aquatic Science
Ceriodaphnia dubia			EPA 1989	Columbia Analytical

* Total recoverable metals method.

** Total metals method.

\+ Antimony, Arsenic, Lead, Selenium and Thallium by Graphite Furnace (GFAA). Mercury by Cold Vapor (CVA). All other metals by Inductively Coupled Plasma (ICP).

Beckman Microtox™ System Operating Manual, 1982.

Ecology Static Acute Fish Toxicity Test, Biological Testing Methods, July 6 1981 revision. DOE 80-12.

EPA 1983 Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020, revised March 1983.

EPA 1986 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846, 3rd ed., November 1986.

EPA 1989 Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. EPA 600/4-89-001. 1989.

SM-17 APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater. 17th ed., 1989.

Tetra Tech Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, 1986.

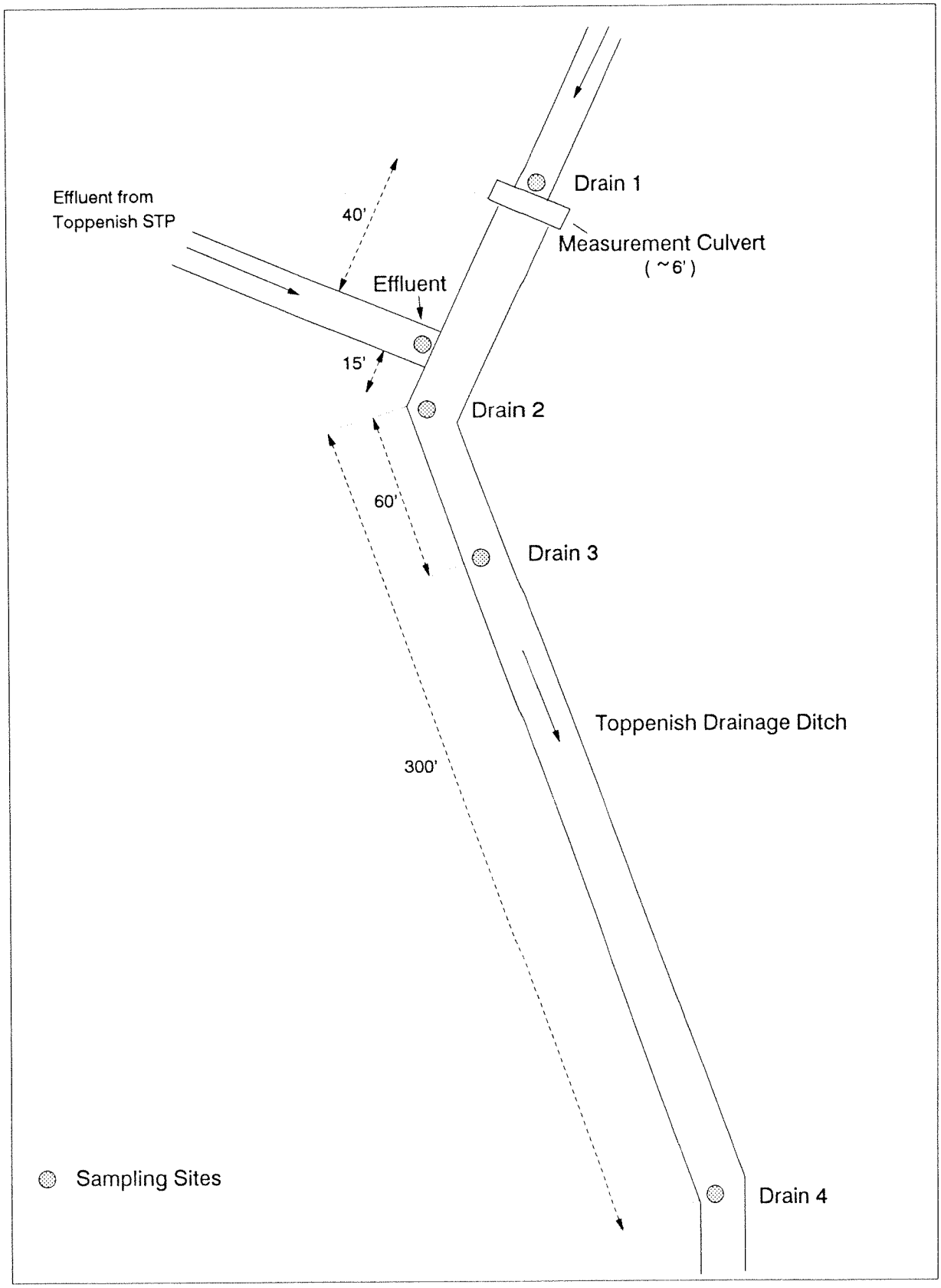
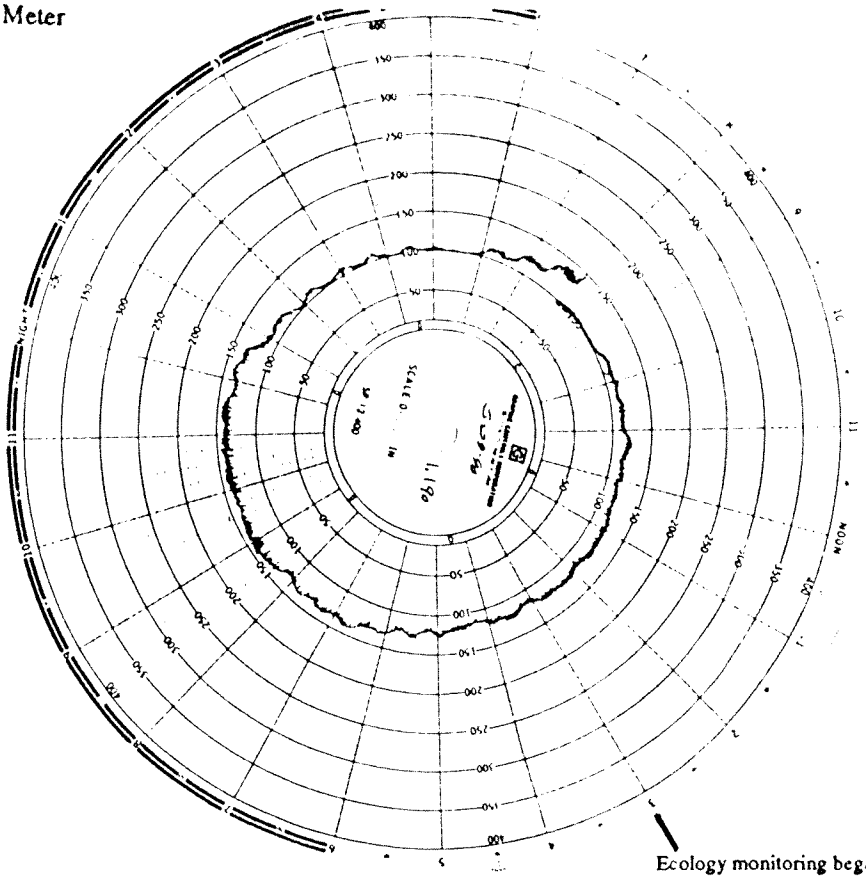


Figure 2. Toppenish Drainage Ditch Sampling Locations - May 1990.

Table 3. Comparison of STP and Ecology Instananeous Flows - Toppenish, May 1990.

Date	Time	Plant Meter	Ecology Meter
5/29/90	17:00	1.25 MGD	1.245 MGD
5/30/90	09:05	1.5 MGD	1.65 MGD
	(rags removed)	1.6 MGD	1.6 MGD

Toppenish Plant Flow Meter



Ecology monitoring began at approximately 3:00PM (see chart below)

Ecology Marsh-McBirney Flo-Tote® Flowmeter

Instrument serial number A70500

flow from appro. 1500 - 5/29 to 0930 - 5/30

Data file modification # 0
Report from: 05/29/90 14:57:10
Report to : 05/30/90 09:27:10
Site Identification:
TOPPENISH_____
CLASS_II_____
INSPECTION_____.

x = LEVEL from -2.000000 to 10.000000 IN.
o = FLOW RATE from -0.400000 to 2.000000 MGD

DATE	TIME
05/29	14:57
05/29	15:57
05/29	16:57
05/29	17:57
05/29	18:57
05/29	19:57
05/29	20:57
05/29	21:57
05/29	22:57
05/29	23:57
05/30	00:57
05/30	01:57
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05/30	07:57
05/30	08:57

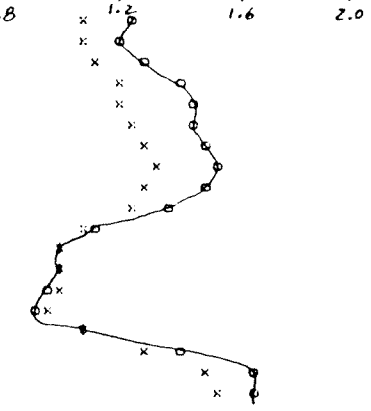


Figure 3. Comparison of Toppenish and Ecology Flow Meter Strip Charts

Table 4. Ecology Laboratory General Chemistry Results - Toppenish, May 1990.

Sample:	Influent	Influent	Influent	Influent	Influent	Effluent	Effluent	Effluent	Effluent	Effluent	Effluent
Lab Log #:	228080	228081		228082	228083	228084	228085		228087	228088	228090
Sampler:	Ecology	Ecology	Ecology	Ecology	Toppenish	Ecology	Ecology	Ecology	Ecology	Ecology	Toppenish
Date:	5/29	5/29	5/30	5/29-30	5/29-30	5/29	5/29	5/30	5/30	5/29-30	5/29
Time:	1115	1620	0845	1000-1000	0900-0900	1045	1640	0850	1025	1000-1000	*
Type:	Grab	Grab	Grab	Comp	Comp	Grab	Grab	Grab	Grab	Comp	Comp
Field Analysis											
Conductivity (umhos/cm)	524	467	447	442	433	462	467	440	430	464	454
pH (S.U.)	7.49	7.42	7.36	7.51	7.28	6.92	7.15	7.06	6.96	7.25	7.15
Temperature (C)	19.2	20.3	18.6	4.3	7.6	18.5	20.1	18.3	18.5	4.4	5.8
Chlorine Residual (mg/L)											
Free						<0.1	<0.1	0.5	0.3		
Total						1.5	1.2	0.6	0.8	0.8	
Dissolved Oxygen (mg/L)											
Flow (MGD)											
Laboratory Analysis											
Turbidity (NTU)										8.3	7.2
Conductivity (umhos/cm)				493	478	488	492			474	482
Alkalinity (mg/L as CaCO3)				170	176	138	152			136	138
Hardness (mg/L as CaCO3)				94.9	99.1	99.1	96.4			96.0	94.5
Chloride (mg/L)				23.2	23.7	33.3	31.8			32.7	32.2
TS (mg/L)				LAC	LAC					LAC	LAC
TNVS (mg/L)				LAC	LAC					LAC	LAC
TSS (mg/L)				84	104	7	11			12	9
TNVSS (mg/L)				18	20					3	2
BOD5 (mg/L)				115	124					21	14
Inhib. BOD5 (mg/L)				85	84					19	12
COD (mg/L)				235.0	252.0	71.0	63.3			71.8	62.9
TOC (%)											
NH3-N (mg/L)				10.3	9.93	6.99	8.44			7.56	7.90
NO3+NO2-N (mg/L)				2.13	2.26	5.35	4.16			4.10	4.90
Total-P (mg/L)				4.55	5.18	5.52	4.86			4.88	4.89
Fecal Coliform (#/100 mL)									3		
Total Coliform (#/100 mL)									333		
% Solids											
% Volatile Solids											

* Hand composite - equal volumes collected hourly between 0800 and 1700.
** Collected at discharge to Drain.
\+ Ecology 1988.
++ Shall not exceed 5 NTU over background turbidity when background turbidity is 50 NTU or less.
L Total plate count greater than 200.
P Greater than (>).
X Many background organisms.
LAC Samples lost in laboratory accident.

Total chlorine residual in the final effluent ranged from 0.6 to 1.5 mg/L (Table 4). The target chlorine residual of approximately 1.0 mg/L was unusually high. Also, the point of chlorination, prior to the secondary clarifier was unusual. Because the effluent is mixed with water in the Toppenish Drain for later use in irrigation, a total coliform concentration, rather than a fecal coliform concentration, is targeted during the irrigation season. To help eliminate total coliforms, the 1.0 mg/L chlorine residual and extra detention time (gained by chlorinating prior to secondary clarification) are used. By chlorinating before final clarification, algal growth in the clarifier is discouraged as well.

The applicable total coliform limit for spray irrigation of food crops with treated wastewater (2.2 organisms/100 mL), is contained in the document Guidelines for Land Disposal of Treated Domestic Sewage Effluent in Washington State issued jointly by Ecology and the Department of Health (1980 update). Total coliforms were measured in the effluent at 333 organisms per 100 mL and 3,100 organisms per 100 mL. Both measurements exceeded the Guidelines limit by two and three orders of magnitude, respectively. The STP discharge monitoring reports include the total coliform concentration in the effluent and the calculated STP contribution to the total coliform concentration in the receiving water (Toppenish Drain). Based on the inspection results, the STP total coliform contribution to the concentrations in the drain was 13.6 and 126 organisms per 100 mL. The existing permit does not contain a numerical total coliform limit, but the necessity of a total coliform requirement will be specifically addressed in the new NPDES permit (Zehm, 1990). The acceptability of the relatively high effluent chlorine residual concentration should also be evaluated.

Permit limits for monthly and weekly average BOD_5, TSS, and fecal coliforms were met with the exception of BOD_5 removal percentage (Table 5). Based on the Ecology influent and effluent composite results, 82% removal of BOD_5 was achieved; slightly below the 85% monthly average removal requirement. A weak influent BOD_5 (115 mg/L) is a factor in the somewhat marginal BOD_5 removal. Permit requirements for pH and flow were met.

Priority Pollutants Detected

Effluent

Four volatile organics; acetone, chloroform, toluene, and 1,4-dichlorobenzene were measured in the effluent at low levels (<25 μg/L) well below established freshwater acute and chronic criteria (EPA, 1986) (Table 6).

Copper, present in the effluent at 19 μg/L, exceeded the acute (13.4 μg/L) and chronic (9.2 μg/L) criteria for freshwater calculated using the average of four hardness measurements made in the Toppenish Drainage Ditch. Lead, mercury, and zinc were measured at levels exceeding chronic criteria (Table 6). Dilution with the Toppenish Drain receiving water (24:1 during this inspection) should reduce the metals concentrations to non-toxic levels.

Complete influent and effluent priority pollutant scans are included in Appendix B.

Table 4. Ecology Laboratory General Chemistry Results – Toppenish, May 1990 (continued).

Sample:	Sludge	Ditch 1	Effluent**	Ditch 2	Ditch 3	Ditch 4	Expected Concentration after complete mixing (calculated)	Receiving Water Criteria+
Lab Log #:	228091	228092	228086	228093	228094	228095		
Sampler:	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology		
Date:	5/30	5/30	5/30	5/30	5/30	5/30		
Time:	0905	1135	1145	1200	1220	1235		
Type:	Grab	Grab	Grab	Grab	Grab	Grab		
Field Analysis								
Conductivity (umhos/cm)		160	412	254	223	198		
pH (S.U.)		7.49	7.05	7.20	7.27	7.41		6.5-8.5
Temperature (C)		16.0	19.1	17.5	18.0	16.7	16.1	18.0 (maximum)
Chlorine Residual (mg/L)								
Free								
Total		<0.1	0.6	0.1	<0.1	<0.1	0.024	0.019(0.011)+*
Dissolved Oxygen (mg/L)		10.6	9.4	9.5	9.9	10		8.0 (minimum)
Flow (MGD)		33	1.4					
Laboratory Analysis								
Turbidity (NTU)		5.8	7.6	7.1	6.8	6.8	5.9	++
Conductivity (umhos/cm)		170	406	246	218	190	180	
Alkalinity (mg/L as CaCO3)		78	124	88	82	78	80	
Hardness (mg/L as CaCO3)		68.3	96.8	83.3	78.7	67.9	69.5	
Chloride (mg/L)		2.99	22.0	8.96	6.54	4.46	3.76	
TS (mg/L)								
TNVS (mg/L)								
TSS (mg/L)		19	13	17	18	21		
TNVSS (mg/L)								
BOD5 (mg/L)								
Inhib. BOD5 (mg/L)								
COD (mg/L)		13.0	55.5	26.4	22.2	12.5	14.7	
TOC (%)	11.5							
NH3-N (mg/L)		0.06	6.02	1.99	1.15	0.46	0.30	12.1(1.77)+**
NO3+NO2-N (mg/L)		1.51	3.66	2.19	1.91	1.69	1.60	
Total-P (mg/L)		0.11	3.39	1.15	0.70	0.31	0.24	
Fecal Coliform (#/100 mL)		5200	26	7200 L	4500	4100		100 (geometric mean)
Total Coliform (#/100 mL)		6700 PX	3100	6700 PX	6700 PX	6700 PX		
% Solids	86.0							
% Volatile Solids	66.0							

* Hand composite – equal volumes collected hourly between 0800 and 1700.
** Collected at discharge to Drain.
\+ Ecology 1988.
++ Shall not exceed 5 NTU over background turbidity when background turbidity is 50 NTU or less.
L Total plate count greater than 200.
P Greater than (>).
X Many background organisms.
LAC Samples lost in laboratory accident.
+* acute(chronic) toxicity criteria.
+** acute(chronic) toxicity criteria calculated for temperature = 17.5 C and pH = 7.5.

Table 5. NPDES Permit Limits and Inspection Results – Toppenish, May 1990.

	NPDES Permit Limits		Ecology Inspection Results		
Parameter	Monthly Average	Weekly Average	composite	grabs	(date-time)
BOD(5)*					
mg/l	30	45	21		
lbs/day	338	507	208		
% removal	85		82		
TSS*					
mg/l	30	45	12		
lbs/day	338	407	119		
% removal	85		86		
Fecal coliform					
#/100 ml	200	400		3	(5/30 10:25)
				26	(5/30 11:45)+
pH	Shall not be outside the range of 6.0 to 9.0			6.9	(5/29 10:45)
				7.2	(5/29 16:40)
				7.1	(5/30 08:50)
				7.0	(5/30 10:25)
				7.1	(5/30 11:45)+
Flow (MGD)	1.35		1.19**		

* The monthly average effluent concentration limitations for BOD(5) and TSS shall not exceed 30 mg/l or 15 percent of the respective influent concentrations, whichever is more stringent.

** 24 hour flow measured by Toppenish.

\+ Sample collected as the effluent discharged into the Toppenish Drain.

Table 6. Priority Pollutants Detected – Toppenish, May 1990.

Sample:	Influent			Effluent			EPA Freshwater Criteria+ (µg/l)	
Lab Log #:	228080	228081	228082	228084	228085	228088		
Sampler:	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology		
Date:	5/29	5/29	5/29-30	5/29	5/29	5/29-30		
Time:	1115	1620	1000-1000	1045	1640	1000-1000		
Type:	grab	grab	composite	grab	grab	composite	Acute	Chronic
VOA Compounds (µg/l)								
Acetone	64	77		18	25		--	--
Chloroform	4.2	5.3		1.5	1.0		28,900 *	1,240 *
Toluene	2.9	2.0		1.9	1.1		17,500 *	--
Tetrachloroethene	2.9	61		1 U	1 U		5,280 *	840 *
1,4-Dichlorobenzene	4.2	3.9		1.4	1.4		1,120 **	763 **
Pesticide/PCB Compounds (µg/l)								
gamma-BHC (Lindane)			0.02 NJ			0.04 U	2.0	0.08
Metals (µg/l)*+								
Antimony			3			1	9,000 *	1,600 *
Arsenic			5			4	360	190
Copper			39			19 AC	13.4 ++	9.2 ++
Lead			10			3 C	56 ++	2.2 ++
Mercury			0.5			0.4 C	2.4	0.012
Selenium			3			2	260	35
Zinc			132			87 C	91 ++	83 ++

U Indicates analyte not detected at given quantitation limit.
NJ Indicates presumptive evidence of the presence of the material at an estimated quantity.
C Exceeds chronic criteria.
A Exceeds acute criteria.
+ EPA 1986.
++ Hardness dependent criteria based on 74.6 mg/l hardness as CaCO3 in Toppenish Ditch receiving water (average of four determinations).
* LOEL (lowest observable effects level).
** LOEL for total dichlorobenzenes.
*+ Total recoverable metals analysis except Mercury which is a total metal analysis.

Sludge

A priority pollutant metals analysis conducted on the digested sludge revealed metals concentrations typical of those reported in the National Sewage Sludge Survey (EPA, 1990) for publicly owned treatment works (POTWs) with flows between one and 10 MGD (Table 7). All sludge metal results were within one standard deviation of the reported geometric means.

Effluent Bioassay Results

The effluent was not toxic to either *Ceriodaphnia dubia* (seven day survival and reproduction test) or fathead minnow (seven day survival and growth test) with both organisms showing no observable effects concentrations (NOECs) of 100% effluent for both the acute (survival) and chronic (reproduction or growth) portions of the tests (Table 8). Note: In the fathead minnow test, a fungus infection appeared to affect sample replicates more than controls, however, using Dunnett's test, the difference in mortality was not significant (Stinson, 1990).

Rainbow trout survival was 100% after 96 hours in effluent dechlorinated with sodium thiosulfate. Microtox® results on dechlorinated effluent indicated an EC_{50} (15 minutes) of 40.4% effluent.

Laboratory Review/Sample Splits

Laboratory procedures appeared very good at the plant. Only minor suggestions were made as noted in the "Laboratory Procedure Review Sheet" (Appendix C).

Agreement between laboratories on split samples was generally good (Table 9). The relative percent difference (RPD - defined as the difference between results divided by their average and expressed as a percentage) between laboratories was $< 20\%$ for all BOD_5 analyses. TSS results did not correspond as well with RPDs $> 30\%$ for two of the four analyses compared. Excellent agreement between laboratories was indicated in total coliform numbers and total chlorine residual results.

Agreement between the Ecology and Toppenish influent automatic samplers appears good. Indications are that a slightly stronger effluent was obtained by the Ecology composite sampler (Table 9). Sample collection procedures could be a factor: Ecology effluent samples were composited automatically for 24 hours, while the STP effluent sample was composited manually for a 9-hour period (08:00 - 17:00). The permit requires a 24 hour effluent composite.

Toppenish Drainage Ditch Receiving Water Study

The receiving water for the STP is the Yakima River via the East Toppenish Drain of the Wapato Irrigation Project. The drain is classified as a Class A water in the Water Quality Standards for Surface Waters of the State of Washington (Ecology, 1988).

Table 7. Sludge Analysis – Toppenish, May 1990.

	Sample:	Sludge		National Sewage Sludge Survey+			
	Lab Log #:	228091					
	Sampler:	Ecology					
	Date:	5/30					
	Time:	0905		Geometric Mean	Standard Deviation	Number of POTWs Sampled	Percent Detect*
	Type:	Grab					
Metals – total (mg/kg–dry)							
Antimony		0.26		--	--	--	--
Arsenic		7.4		9.72	10.91	70	83
Beryllium		0.605	U	0.48	0.41	70	36
Cadmium		4.67		9.16	10.72	69	78
Chromium		24.2	NC	160.57	286.16	70	99
Copper		670		670.68	702.50	70	100
Lead		115		156.99	150.58	70	87
Mercury		2.51		3.96	3.64	70	79
Nickel		19		48.36	49.23	70	81
Selenium		10		5.59	5.98	70	64
Silver		14.3		--	--	--	--
Thallium		0.08		--	--	--	--
Zinc		1120	J,NC	1707.99	2346.10	70	100
General Chemistry							
TOC (%–dry weight)		11.5					
Solids (%)		86.0					
Volatile Solids (%)		66.0					

— Indicates no survey data.
\+ EPA 1990. Values presented are for publicly owned treatment works (POTWs) with flows between 1 and 10 MGD.
* Percent of POTWs in which the analyte was detected above an assigned minimum level.
U Indicates analyte was not detected at the given detection limit.
J Indicates an estimated value.
NC Indicates QA/QC control limits were exceeded.

Table 8. Effluent Bioassay Results – Toppenish, May 1990.

Ceriodaphnia dubia - 7 day survival and reproduction test
(Ceriodaphnia dubia)

Sample	# Tested	Percent Survival	Mean # Young per Original Female
Control	10	100	15
6.25 % Effluent	10	100	16
12.5 % Effluent	10	100	20
25 % Effluent	10	100	19
50 % Effluent	10	100	18
100 % Effluent	10	100	15

Acute	Chronic
NOEC = 100 % effluent	NOEC = 100 % effluent

Fathead Minnow - 7 day survival and growth test
(Pimephales promelas)

Sample	# Tested *	Percent Survival **	Mean Weight per Fish (mg)
Control	60	85.0	0.341
6.25 % Effluent	60	61.7	0.393
12.5 % Effluent	60	55.0	0.417
25 % Effluent	60	51.7	0.369
50 % Effluent	60	55.0	0.390
100 % Effluent	60	56.7	0.319

Acute	Chronic
NOEC = 100 % effluent LC50 = >100 % effluent	NOEC = 100 % effluent

* Four replicates of 15 organisms.
** A fungus infection affected sample mortalities more than the control. Using Dunnett's test, the differences were not significant.

Rainbow Trout - 96 hour survival test
(Oncorhynchus mykiss)

Sample	# Tested	Percent Survival
Control	30	100
Thio Control **	30	100
100% Effluent	30	100

** Sample was dechlorinated prior to test. Initial chlorine concentration of 0.6 mg/L removed with sodium thiosulfate addition equal to that in the Thio Control.

Microtox

	EC50 + (% effluent)	Toxicity Ranking ++
15 minutes	40.4	moderate

\+ Sample dechlorinated with sodium thiosulfate prior to test.
++ EPA, 1980.

NOEC - no observable effects concentration
LOEC - lowest observable effects concentration
LC50 - lethal concentration for 50% of the organisms
EC50 - effect concentration for 50% of the organisms

Table 9. Comparison of Laboratory Results - Toppenish, May 1990.

Station	Date	Type (Time)	Sampler	Laboratory	BOD(5) (mg/l)	TSS (mg/l)	Total Coliforms (#/100 ml)	Total Chlorine Residual (mg/l)
Influent	5/29	composite (1000-1000)	Ecology	Ecology	115	84		
				Toppenish	133	124		
				(RPD)	(15%)	(38%)		
		composite (0900-0900)	Toppenish	Ecology	124	104		
				Toppenish	123	122		
				(RPD)	(0.8%)	(16%)		
Effluent	5/29	composite (1000-1000)	Ecology	Ecology	21	12		
				Toppenish	25	17		
				(RPD)	(17%)	(34%)		
		composite* (0800-1700)	Toppenish	Ecology	14	9		
				Toppenish	17	10		
				(RPD)	(19%)	(11%)		
	5/30	grab (1025)	Ecology	Ecology			333	0.8
				Toppenish			319	0.8
				(RPD)			(4%)	(0%)

RPD Relative percent difference - defined as the difference between results divided by their average and expressed as a percentage.

* Hand composite - equal volumes collected hourly from 0800 to 1700

Drain flow was 33 MGD and effluent flow was 1.4 MGD for an effluent dilution of 24:1 at the time samples were collected in the Toppenish Drain.

All of the samples collected in the drain (both upstream and downstream of the effluent discharge point) had substantially higher fecal coliform concentrations (150 - 275 times) than the STP effluent concentration (26 organisms/100 mL). Fecal coliform concentrations measured approximately 75 feet and 300 feet downstream of the effluent discharge point were slightly lower than the upstream concentration (Figure 4). All fecal coliform concentrations measured in the drain violated the water quality standard for Class A waters (Table 4 and Appendix D). Total coliform concentrations in the drain were all greater than 6700 organisms/100 mL, more than two times the effluent concentration (3100 organisms/100 mL). The total chlorine residual concentration calculated for the completely mixed condition (0.025 mg/L) was slightly greater than the acute toxicity criteria (0.019 mg/L). Chlorine consumption in the ditch was probably adequate to further reduce chlorine concentrations to less than toxicity criteria.

For many of the parameters measured, it appears that at approximately 300 feet downstream of the effluent discharge point, mixing with the receiving water was complete (Table 4 and Figures 5 and 6). Nutrients, conductivity and chloride were slightly greater than the upstream concentrations and the D.O. was slightly depleted. Dissolved oxygen, temperature, pH, and turbidity met the applicable water quality standards for Class A waters (Table 4 and Appendix D). The ammonia concentration calculated for the completely mixed condition was less than toxicity criteria.

Conclusions and Recommendations

The plant appeared well maintained and well operated during the inspection.

The STP in-plant flowmeter was accurate.

The effluent was within permit limits for BOD_5, TSS, fecal coliforms, and pH with the exception of BOD_5 removal which was slightly less than the required 85%. Removal efficiencies were 82% for BOD_5 and 86% for TSS. Although the total chlorine residual was high (0.8 mg/L), total coliforms measured in the effluent were 333/100 mL and 3100/100 mL exceeding by two and three orders of magnitude the guidelines established for wastewater used for spray irrigation of food crops (2.2/100 mL). Total coliform limits are scheduled to be addressed when the permit is revised. An acceptable effluent chlorine residual concentration should also be addressed.

Four organics (VOAs) were detected in the effluent at very low levels (<25 μg/L). Copper was measured at an effluent concentration exceeding acute and chronic criteria (based on the hardness in the Toppenish Drain). Effluent lead, mercury, and zinc concentrations exceeded chronic criteria. Dilution in the receiving water should reduce the metals to non-toxic levels.

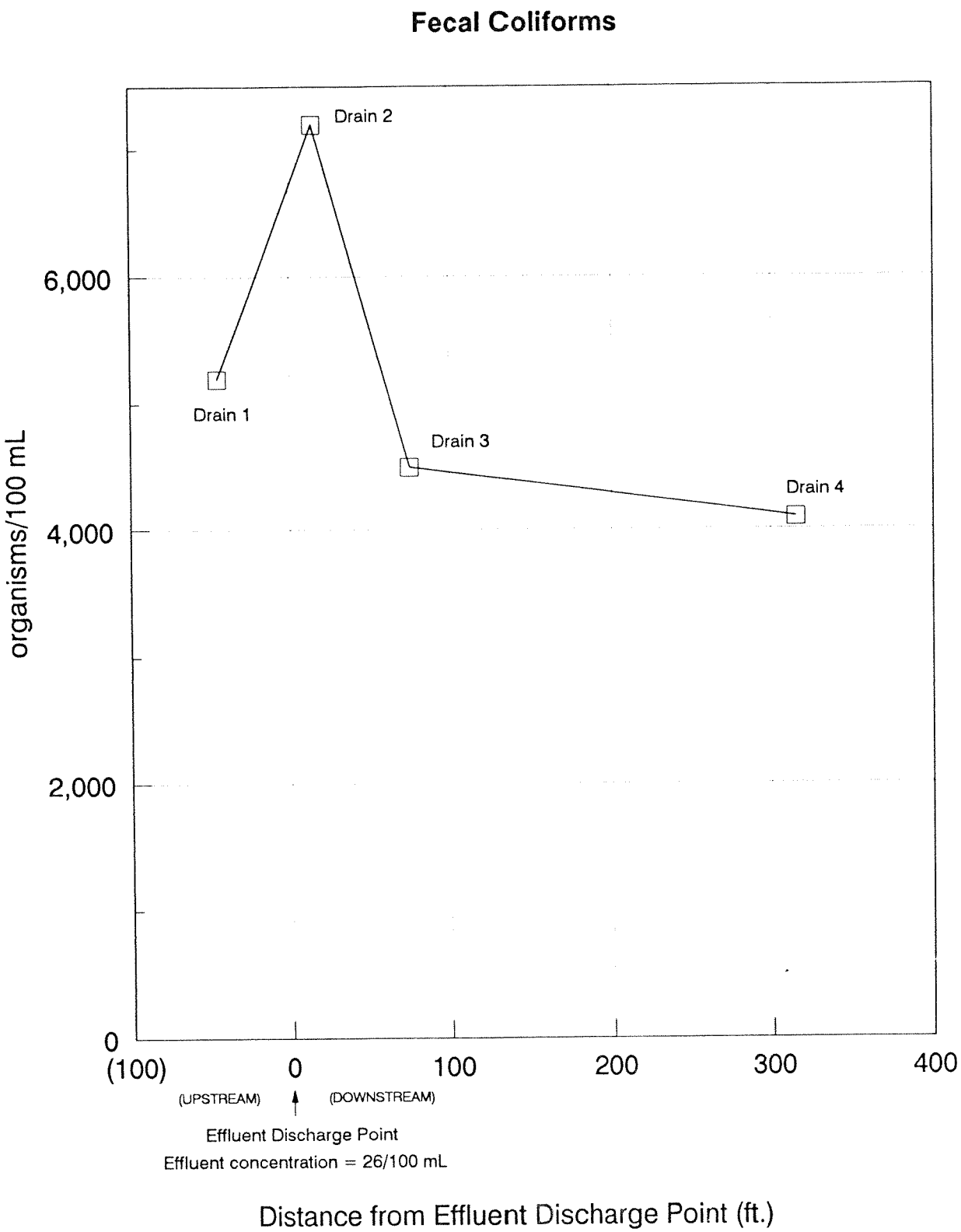
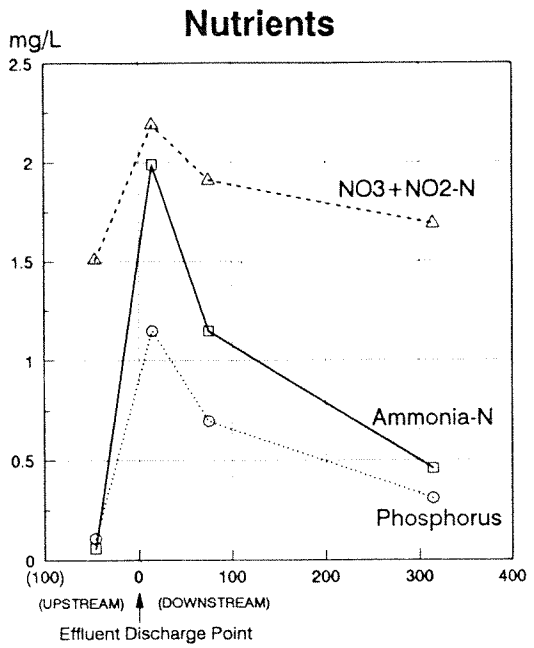
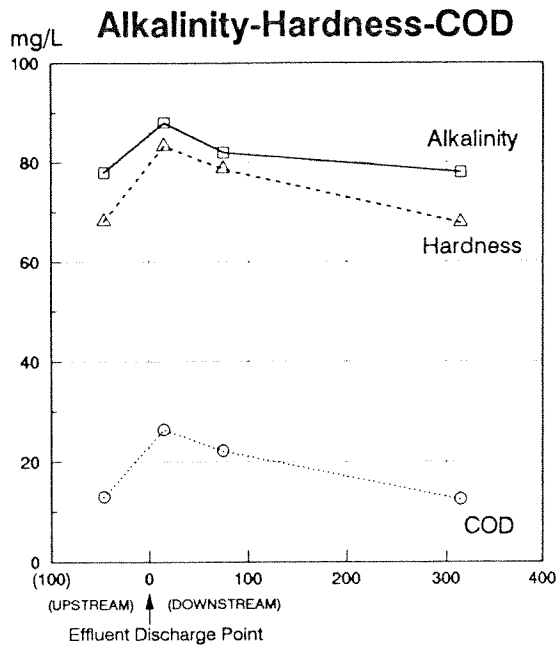


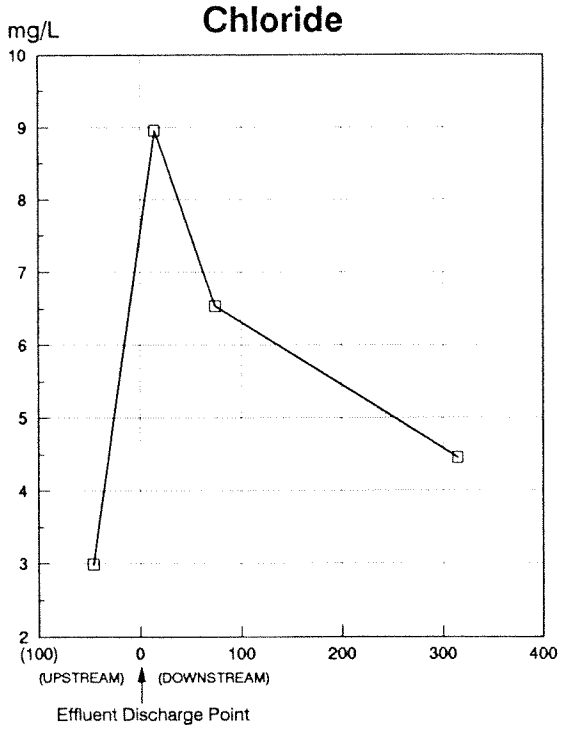
Figure 4. Profile of Fecal Coliform Concentrations in Toppenish Drain



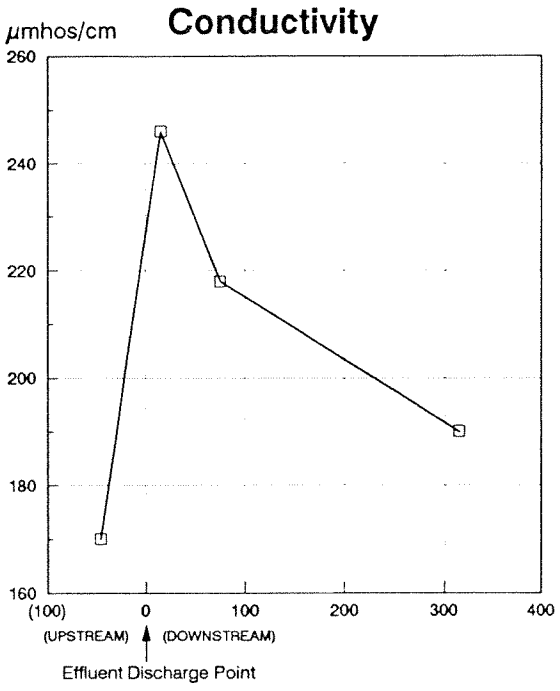
Effluent concentrations	Expected concentrations*
3.66 mg/L NO3+NO2-N	1.60 mg/L NO3+NO2-N
6.02 mg/L Ammonia-N	0.30 mg/L Ammonia-N
3.39 mg/L Phosphorus	0.24 mg/L Phosphorus



Effluent concentrations	Expected concentrations*
124 mg/L alkalinity	80 mg/L alkalinity
96.8 mg/L hardness	69.5 mg/L hardness
55.5 mg/L COD	14.7 mg/L COD



Effluent concentration = 22.0 mg/L
Expected concentration* = 3.76 mg/L



Effluent value = 406 µmhos/cm
Expected value* = 180 µmhos/cm

* Expected value assuming complete mixing of effluent and Drain
Samples collected an arms length from the effluent discharge side of the Drain

Figure 5. Effects of STP Effluent on Toppenish Drain

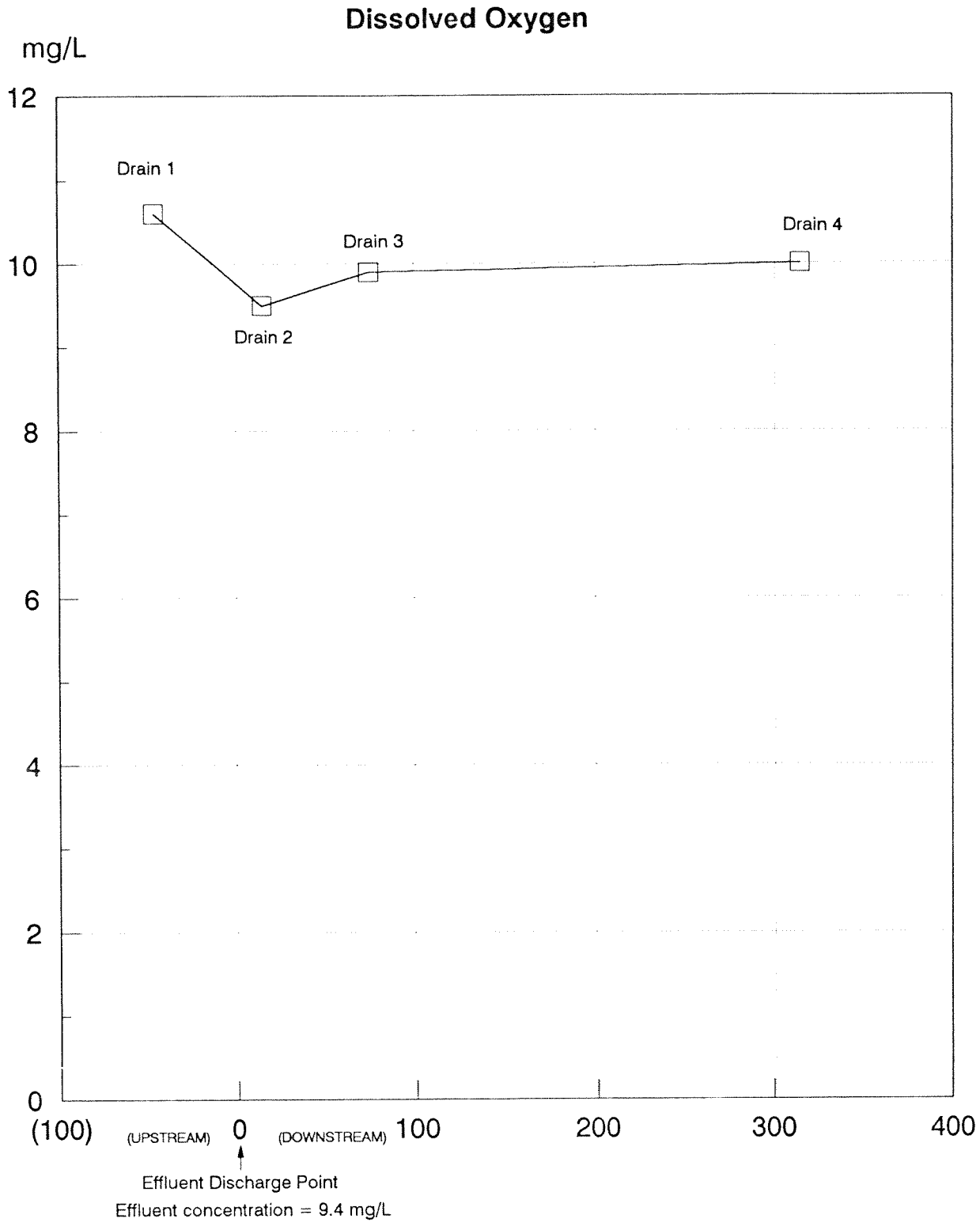


Figure 6. Profile of Dissolved Oxygen Concentrations in Toppenish Drain

Bioassays conducted with *Ceriodaphnia dubia*, fathead minnow, and rainbow trout indicated no effluent toxicity. Microtox had an EC_{50} (15 minutes) of 40.4% effluent.

Plant laboratory procedures appeared very good. Split samples compared well with the exception of two sets of TSS results which had RPDs >30%. Ecology's effluent sample appeared slightly stronger than the STP's. The Toppenish effluent sample was composited from 08:00 to 17:00. The permit requires a 24 hour composite sample. An effluent automatic composite sampler is recommended.

Background fecal and total coliform numbers were greater in the Toppenish Drain than in the STP effluent. The STP effluent appeared completely mixed approximately 300 feet downstream of the discharge point. Fecal coliforms exceeded water quality standards for Class A waters. Water quality standards for Class A waters were met for D.O., temperature, pH and turbidity.

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APPENDICES

Appendix A. Priority Pollutant Cleaning Procedures – Toppenish, May 1990.

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse with 10% Nitric Acid
4. Rinse three times with distilled/deionized water
5. Rinse with high purity methylene chloride
6. Rinse with high purity acetone
7. Allow to dry and seal with aluminum foil

Appendix B. Priority Pollutant Scan Results – Toppenish, May 1990.

	Sample:	Influent	Influent	Effluent	Effluent
	Lab Log #:	228080	228081	228084	228085
	Sampler:	Ecology	Ecology	Ecology	Ecology
	Date:	5/29	5/29	5/29	5/29
	Time:	1115	1620	1045	1640
	Type:	Grab	Grab	Grab	Grab
VOA Compounds		(µg/l)	(µg/l)	(µg/l)	(µg/l)
Chloromethane		1 U	1 U	1 U	1 U
Vinyl Chloride		1 U	1 U	1 U	1 U
Bromomethane		1 U	1 U	1 U	1 U
Chloroethane		1 U	1 U	1 U	1 U
Trichlorofluoromethane		1 U	1 U	1 U	1 U
Freon 113		10 U	10 U	10 U	10 U
1,1-Dichloroethene		1 U	1 U	1 U	1 U
Acetone		64	77	18	25
Carbon Disulfide		1 U	1 U	1 U	1 U
Methylene Chloride		10 U	10 U	10 U	10 U
Trans 1,2-Dichloroethene		1 U	1 U	1 U	1 U
Cis 1,2-Dichloroethene		1 U	1 U	1 U	1 U
2-Butanone (MEK)		10 U	10 U	10 U	10 U
1,1-Dichloroethane		1 U	1 U	1 U	1 U
Chloroform		4.2	5.3	1.5	1.0
1,1,1-Trichloroethane		1 U	1 U	1 U	1 U
Carbon Tetrachloride		1 U	1 U	1 U	1 U
Benzene		1 U	1 U	1 U	1 U
1,2-Dichloroethane		1 U	1 U	1 U	1 U
Vinyl Acetate		10 U	10 U	10 U	10 U
Trichloroethene		1 U	1 U	1 U	1 U
1,2-Dichloropropane		1 U	1 U	1 U	1 U
Bromodichloromethane		1 U	1 U	1 U	1 U
2-Chloroethylvinyl ether		10 U	10 U	10 U	10 U
Trans 1,3-Dichloropropene		1 U	1 U	1 U	1 U
2-Hexanone		10 U	10 U	10 U	10 U
4-Methyl-2-Pentanone		10 U	10 U	10 U	10 U
Toluene		2.9	2.0	1.9	1.1
Cis 1,3-Dichloropropene		1 U	1 U	1 U	1 U
1,1,2-Trichloroethane		1 U	1 U	1 U	1 U
Tetrachloroethene		2.9	81	1 U	1 U
Dibromochloromethane		1 U	1 U	1 U	1 U
Chlorobenzene		1 U	1 U	1 U	1 U
Ethylbenzene		1 U	1 U	1 U	1 U
Styrene		1 U	1 U	1 U	1 U
Total Xylenes		1 U	1 U	1 U	1 U
Bromoform		1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane		1 U	1 U	1 U	1 U
1,3-Dichlorobenzene		1 U	1 U	1 U	1 U
1,4-Dichlorobenzene		4.2	3.9	1.4	1.4
1,2-Dichlorobenzene		1 U	1 U	1 U	1 U
Tentatively Identified Components (TIC)					
Limonene		4 J	8 J		

Appendix B. Priority Pollutant Scan Results – Toppenish, May 1990 (continued).

	Sample:	Influent	Effluent
	Lab Log #:	228082	228088
	Sampler:	Ecology	Ecology
	Date:	5/29–30	5/29–30
	Time:	1000–1000	1000–1000
	Type:	Comp	Comp
BNA Compounds		(µg/l)	(µg/l)
Phenol		25 U	5 U
2–Chlorophenol		25 U	5 U
Benzyl Alcohol		25 U	5 U
2–Methylphenol		25 U	5 U
4–Methylphenol		25 U	5 U
2–Nitrophenol		25 U	5 U
2,4–Dimethylphenol		25 U	5 U
Benzoic Acid		250 U	50 U
2,4–Dichlorophenol		25 U	5 U
4–Chloro–3–Methylphenol		25 U	5 U
2,4,6–Trichlorophenol		25 U	5 U
2,4,5–Trichlorophenol		25 U	5 U
2,4–Dinitrophenol		250 U	50 U
4–Nitrophenol		250 U	50 U
4,6–Dinitro–2–Methylphenol		100 U	20 U
Pentachlorophenol		100 U	20 U
N–Nitrosodimethylamine		25 U	5 U
Aniline		25 U	5 U
Bis(2–Chloroethyl)Ether		25 U	5 U
1,3–Dichlorobenzene		25 U	5 U
1,4–Dichlorobenzene		25 U	5 U
1,2–Dichlorobenzene		25 U	5 U
Bis(2–chloroisopropyl)ether		25 U	5 U
N–Nitroso–Di–n–Propylamine		25 U	5 U
Hexachloroethane		25 U	5 U
Nitrobenzene		25 U	5 U
Isophorone		25 U	5 U
Bis(2–Chloroethoxy)Methane		25 U	5 U
1,2,4–Trichlorobenzene		25 U	5 U
Naphthalene		25 U	5 U
4–Chloroaniline		25 U	5 U
Hexachlorobutadiene		25 U	5 U
2–Methylnaphthalene		25 U	5 U
Hexachlorocyclopentadiene		25 U	5 U
2–Chloronaphthalene		25 U	5 U
2–Nitroaniline		100 U	20 U
Dimethyl Phthalate		25 U	5 U
Acenaphthylene		25 U	5 U
3–Nitroaniline		100 U	20 U
Acenaphthene		25 U	5 U
Dibenzofuran		25 U	5 U
2,4–Dinitrotoluene		25 U	5 U
2,6–Dinitrotoluene		25 U	5 U
Diethyl Phthalate		25 U	5 U
4–Chlorophenyl–Phenylether		25 U	5 U
Fluorene		25 U	5 U
4–Nitroaniline		100 U	20 U
N–Nitrosodiphenylamine		25 U	5 U
4–Bromophenyl–Phenylether		25 U	5 U
Hexachlorobenzene		25 U	5 U
Phenanthrene		25 U	5 U
Anthracene		25 U	5 U
Di–n–Butyl Phthalate		25 U	5 U
Fluoranthene		25 U	5 U

Appendix B. Priority Pollutant Scan Results - Toppenish, May 1990 (continued).

	Sample:	Influent	Effluent
	Lab Log #:	228082	228088
	Sampler:	Ecology	Ecology
	Date:	5/29-30	5/29-30
	Time:	1000-1000	1000-1000
	Type:	Comp	Comp
Pyrene		25 U	5 U
Butylbenzylpthalate		25 U	5 U
3,3'-Dichlorobenzidine		25 U	5 U
Benzo(a)Anthracene		25 U	5 U
Bis(2-Ethylhexyl)phthalate		25 U	5 U
Chrysene		25 U	5 U
Di-n-Octyl Phthalate		25 U	5 U
Benzo(b)Fluoranthene		25 U	5 U
Benzo(k)Fluoranthene		25 U	5 U
Benzo(a)Pyrene		25 U	5 U
Indeno(1,2,3-cd)Pyrene		25 U	5 U
Dibenzo(a,h)Anthracene		25 U	5 U
Benzo(g,h,i)Perylene		25 U	5 U
Tentatively Identified Components (TIC)			
Dihydroterpineol		20 J	
1-alpha-terpineol		110 J	7 J
Dodecanoic Acid		40 J	5 J
Tetradecanoic Acid		95 J	8 J
Caffeine			4 J
Pentadecanoic Acid		20 J	
9-Octadencenoic Acid		670 J	43 J
Octadecanoic Acid		395 J	13 J
Hexamethyl-tetracosahexaene Isomer		90 J	11 J
(3-alpha,5-alpha)-Cholestan-3-ol			134 J
Cholestan-4-one		80 J	23 J
Pesticide/PCB Compounds		(µg/l)	(µg/l)
alpha-BHC		0.04 U	0.04 U
gamma-BHC (Lindane)		0.02 NJ	0.04 U
beta-BHC		0.1 U	0.1 U
Heptachlor		0.04 U	0.04 U
delta-BHC		0.04 U	0.04 U
Aldrin		0.04 U	0.04 U
Heptachlor Epoxide		0.04 U	0.04 U
Endosulfan I		0.04 U	0.04 U
4,4'-DDE		0.04 U	0.04 U
Dieldrin		0.04 U	0.04 U
Endrin		0.04 U	0.04 U
4,4'-DDD		0.04 U	0.04 U
Endosulfan II		0.04 U	0.04 U
4,4'-DDT		0.04 U	0.04 U
Endrin Aldehyde		0.04 U	0.04 U
Endosulfan Sulfate		0.04 U	0.04 U
Methoxychlor		0.1 U	0.1 U
Toxaphene		1 U	1 U
Chlordane		0.5 U	0.5 U
Aroclor-1016		0.2 U	0.2 U
Aroclor-1221		0.2 U	0.2 U
Aroclor-1232		0.2 U	0.2 U
Aroclor-1242		0.2 U	0.2 U
Aroclor-1248		0.2 U	0.2 U
Aroclor-1254		0.2 U	0.2 U
Aroclor-1260		0.2 U	0.2 U
No Tentatively Identified Components (TIC)			

Appendix B. Priority Pollutant Scan Results – Toppenish, May 1990 (continued).

	Sample:	Influent		Effluent		Sludge	
	Lab Log #:	228082		228088		228091	
	Sampler:	Ecology		Ecology		Ecology	
	Date:	5/29–30		5/29–30		5/30	
	Time:	1000–1000		1000–1000		0905	
	Type:	Comp		Comp		Grab	
Metals		(mg/l)		(mg/l)		(mg/kg–dry)	
Antimony		0.003		0.001		0.26	
Arsenic		0.005		0.004		7.4	
Beryllium		0.005	U	0.005	U	0.605	U
Cadmium		0.002	U	0.002	U	4.67	
Chromium		0.006	U	0.006	U	24.2	NC
Copper		0.039		0.019		670	
Lead		0.010		0.003		115	
Mercury		0.0005		0.0004		2.51	
Nickel		0.01	U	0.01	U	19	
Selenium		0.003		0.002		10	
Silver		0.010	U	0.010	U	14.3	
Thallium		0.001	U	0.001	U	0.08	
Zinc		0.132		0.087		1120	J,NC

U Indicates compound was analyzed for but not detected at the given detection or quantitation limit.

J Indicates estimated value.

NJ Indicates presumptive evidence of the presence of the presence of the material at an estimated quantity.

NC Indicates QA/QC control limits were exceeded.

Appendix C. Laboratory Review - Toppenish, May 1990.

Discharger: TOPPENISH STP

Date: 5/29/90

Discharger representative: ED MARTINDALE

Ecology reviewer: MARC HEFFNER

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are cited to help give guidance for making improvements. References cited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

SM = APHA-AWWA-WPCF, Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination, 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis? INF - AUTOMATIC
EF - HAND - HOURLY FROM 8-5

2. If automatic compositor, what type of compositor is used?
The compositor should have pre and post purge cycles unless it is a flo through type. Check if you are unfamiliar with the type being used.
MANNING

3. Are composite samples collected based on time or flow? TIME

4. What is the usual day(s) of sample collection? WED - THURS

5. What time does sample collection usually begin? 0800 - 0800

6. How long does sample collection last? 24 hours

7. How often are subsamples that make up the composite collected? hourly

8. What volume is each subsample? 300 ml/s

9. What is the final volume of sample collected? ≈ 2 gals

10. Is the composite cooled during collection? yes

11. To what temperature? should check
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled? mechanical
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

13. How often is the temperature measured? check
The temperature should be checked at least monthly to assure adequate cooling.

14. Are the sampling locations representative? OK

15. Are any return lines located upstream of the influent sampling location? no
This should be avoided whenever possible.

16. How is the sample mixed prior to withdrawal of a subsample for analysis? yes
The sample should be thoroughly mixed.

17. How is the subsample stored prior to analysis? short period
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.

18. What is the cleaning frequency of the collection jugs? OK
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phospate detergent.

19. How often are the sampler lines cleaned? occasionally
Rinsing lines with a chlorine solution every three months or more often where necessary is suggested.

pH Test Review

1. How is the pH measured? corning
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).

2. How often is the meter calibrated? daily
The meter should be calibrated every day it is used.

3. What buffers are used for calibration? 7 suggest once/week
Two buffers bracketing the pH of the sample being tested should be used.

If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test? *Ecology handout*
   Standard Methods or the Ecology handout should be used.

2. How often are BODs run? *weekly*
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? *couple hours*
   The test should begin within 24 hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples are complete is desirable.

4. Is distilled or deionized water used for preparing dilution water?

5. Is the distilled water made with a copper free still? *glass*
   Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36).

6. Are any nitrification inhibitors used in the test? *no* What?
   2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).

7. Are the 4 nutrient buffers of powder pillows used to make dilution water?
   If the nutrients are used, how much buffer per liter of dilution water are added?
   1 mL per liter should be added (SM p527, #5a: SSM p37).

8. How often is the dilution water prepared? *weekly*
   Dilution water should be made for each set of BODs run.

9. Is the dilution water aged prior to use? *made same day*
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

10. Have any of the samples been frozen? *no*
    If yes, are they seeded?
    Samples that have been frozen should be seeded (SSM p38).

11. Is the pH of all samples between 6.5 and 7.5? *yes*
    If no, is the sample pH adjusted?
    The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH o 1N H_2SO_4 if 6.5 > pH >7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37).
    High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

    If the sample pH is adjusted, is the sample seeded?
    The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d).

12. Have any of the samples been chlorinated or ozonated?
If chlorinated are they checked for chlorine residual and dechlorinated as necessary? yes
How are they dechlorinated? yes
Samples should be dechlorinated with sodium sulfite (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosulfate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.
If chlorinated or ozonated, is the sample seeded?
The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).

13. Do any samples have a toxic effect on the BOD test? no
Specific modifications are probably necessary (SM p528, #5d: SSM p37).

14. How are DO concentrations measured? winkler
If with a meter, how is the meter calibrated?
Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not manditory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.

How frequently is the meter calibrated?
The meter should be calibrated before use.

15. Is a dilution water blank run? OK
A dilution water blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).

What is the usual initial DO of the blank? ~8.0
The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletion is a problem .

What is the usual 5 day blank depletion? ~0.1
The depletion should be 0.2 mg/L or less. If the depletion is greater the cause should be found (SM p527-8, #5b: SSM p41, #6).

16. How many dilutions are made for each sample? 1
At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).

17. Are dilutions made by the liter method or in the bottle?
Either method is acceptable (SM p530, #5f). liter except QC check - KHP

18. How many bottles are made at each dilution? 3
How many bottles are incubated at each dilution? 2
When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f2).
When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

19. Is the initial DO of each dilution measured? yes
What is the typical initial DO? 7.5-8.0
The initial DO of each dilution should be measured. It should approximate saturation (see #14).

20. What is considered the minimum acceptable DO depletion after 5 days? OK
What is the minimum DO that should be remaining after 5 days?
The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).

21. Are any samples seeded? Yes
Which?
What is the seed source? 1° ef
Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).

How much seed is added to each sample? 5 mL/1000 mL
Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).

How is the BOD of the seed determined? seed control
Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41).

22. What is the incubator temperature? 20
The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).

How is incubator temperature monitored? thermometer
A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.

How frequently is the temperature checked? in & out
The temperature should be checked daily during the test. A temperature log on the incubator door is recommended.

How often must the incubator temperature be adjusted? seldom
Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.

Is the incubator dark during the test period? yes
Assure the switch that turns off the interior light is functioning.

23. Are water seals maintained on the bottles during incubation? yes
Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

24. Is the method of calculation correct? OK

Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$BOD\ (mg/L) = \frac{D1 - D2}{P}$$

for seeded samples;

$$BOD\ (mg/L) = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
D2 = DO of diluted sample after incubation period (mg/L)
P = decimal volumetric fraction of sample used
B1 = DO of seed control before incubation (mg/L)
B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? - experience - ~~Std Mthds~~ EPA test

2. What type of filter paper is used?
   Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95,footnote: SSM p23)

3. What is the drying oven temperature? 104 (adjust weekly)
   The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).

4. Are any volatile suspended solids tests run? no
   If yes--What is the muffle furnance temperature?
   The temperature should be 550+/- 50 degrees C (SM p98, #3: SSM p23).

5. What type of filtering apparatus is used?
   Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).

6. How are the filters pre-washed prior to use? OK
   The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23, #2).

   Are the rough or smooth sides of the filters up? yes
   The rough side should be up (SM p96, #3a: SSM p23, #1)

   How long are the filters dried? yes
   The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnance is required if volatile solids are to be tested (Ibid).

   How are the filters stored prior to use? yes
   The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? yes
   All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured? cylinder
   The sample should be measured with a wide tipped pipette or a graduate cylinder.

9. Is the filter seated with distilled water? ~~✓~~ suggest
   The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? ~~sug~~ suggest
The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered?

	Volume	
	Minimum	Average
Influent		30-40
Effluent		100

12. How long does it take to filter the samples?

	Time
Influent	3-4 min max
Effluent	

13. How long is filtering attempted before deciding that a filter is clogged? OK
Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum.

14. What do you do when a filter becomes clogged? OK
The filter should be discarded and a smaller volume of sample should used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? ~~sug~~ should rinse cylinder
Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried? 1hr
The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4). Excessive drying times (such as overnight) should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing? 20 min
The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c).

18. How frequently is the drying cycle repeated to assure constant filter weight has ben reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)?
We recommend that this be done at least once every 2 months.

19. Do calculations appear reasonable?
Standard Methods calculation (SM p97, #3c).

$$\text{mg/L TSS} = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

where: A= weight of filter + dried residue (mg)
B= weight of filter (mg)

Fecal Coliform Test Review

1. Is the Membrane Filtration (MF) or Most Probable Number (MPN) technique used?
   This review is for the MF technique.

2. Are sterile techniques used? yes

3. How is equipment sterilizated? autoclave
   Items should be either purchased sterilized or be sterilized. Steam sterilization, 121 degrees C for 15 to 30 minutes (15 psi); dry heat, 1-2 hours at 170 degrees C; or ultraviolet light for 2-3 minutes can be used. See Standard Methods for instructions for specific items (SSM p67-68).

4. How is sterilization preserved prior to item use? OK
   Wrapping the items in kraft paper or foil before they are sterilized protects them from contamination (Ibid.).

5. How are the following items sterilized?

	Purchased Sterile	Sterilized at Plant
Collection bottles		
Phosphate buffer		
Media		
Media pads		
Petri dishes		
Filter apparatus		
Filters		
Pipettes		
Measuring cylinder		
Used petri dishes		

6. How are samples dechlorinated at the time of collection? OK
   Sodium thiosulfate (1 mL of 1% solution per 120 mLs (4 ounces) of sample to be collected) should be added to the collection bottle prior to sterilization (SM p856, #2: SSM p68, sampling).

7. Is phosphate buffer made specifically for this test? OK
   Use phosphate buffer made specifically for this test. The phosphate buffer for the BOD test should not be used for the coliform test (SM p855, #12: SSM p66).

8. What kind of media is used? OK
   M-FC media should be used (SM p896, SSM p66).

9. Is the media mixed or purchased in ampoules?
   Ampoules are less expensive and more convient for under 50 tests per day (SSM p65, bottom).

10. How is the media stored?
    The media should be refrigerated (SM p897, #1a: SSM p66, #5).

11. How long is the media stored? OK
Mixed media should be stored no longer than 96 hours (SM p897, #1a: SSM p66, #5). Ampoules will usually keep from 3-6 months -- read ampoule directions for specific instructions.

12. Is the work bench disinfected before and after testing? cleaned
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use? OK
Dipping in alcohol and flaming are necessary to sterilize the forceps (SM p889, #1: SSM p73, #4).

14. Is sample bottle thoroughly shaken before the test volume is removed? The sample should be mixed thoroughly (SSM p73, #5). OK

15. Are special procedures followed when less than 20 mLs of sample is to be filtered? OK
10-30 mLs of sterile phosphate buffer should be put on the filter. The sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using this technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed when less than 1 mL of sample is to be filtered? N/A
Sample dilution is necessary prior to filtration when <1 mL is to be tested (SM p864, #2c: SSM p69).

17. Is the filter apparatus rinsed with phosphate buffer after sample filtration? OK
Three 20-30 mL rinses of the filter apparatus are recommended (SM p891 #5b: SSM p75, #7).

18. How soon after sample filtration is incubation begun? OK
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77, #10 note).

19. What is the incubation temperature? OK
44.5 +/- 0.2 degrees C (SM p897, #2d: SSM p75, #9).

20. How long are the filters incubated? OK
24 +/- 2 hours (Ibid.).

21. How soon after incubation is complete are the plate counts made? OK
The counts should be made within 20 minutes after incubation is complete to avoid colony color fading (SSM p77, FC).

22. What color colonies are counted? OK
The fecal coliform colonies vary from light to dark blue (SM p897, #2e SSM p78).

23. What magnification is used for counting? OK
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

24. How many colonies blue colonies are usually counted on a plate? <20
Valid plate counts are between 20 and 60 colonies (SM p897, #2a: SSM p78). 5 10 15

25. How many total colonies are usually on a plate? sometimes
The plate should have <200 total colonies to avoid inhabition due to crowding (SM p893, #6a: SSM p63, top).

26. When calculating results, how are plates with <20 or >60 colonies considered when plates exist with between 20 and 60 colonies?
In this case the plates with <20 or >60 colonies should not be used for calculations (SM p898, #3: SSM p78, C&R).

27. When calculating results how are results expressed if all plates have < 20 or > 60 colonies?
Results should be identified as estimated.
The exception is when water quality is good and <20 colonies grow. In this case the lower limit can be ignored (SM p893, #6a: SSM p78, C&R).

28. How are results calculated?
Standard Methods procedure is (SM p893, #6a: SSM p79):

$$\text{Fecal coliforms/100 mL} = \frac{\text{\# of fecal coliform colonies counted}}{\text{sample size (mL)}} \times 100$$

Appendix D. Water Quality Standards for Class A Waters (Ecology, 1988) - Toppenish, May 1990.

Class A (excellent).

I. General characteristic. Water quality of this class shall meet or exceed the requirements for all or substantially all uses.

II. Characteristic uses. Characteristic uses shall include, but not be limited to, the following:

A. Water supply (domestic, industrial, agricultural).

B. Stock watering.

C. Fish and shellfish
1. Salmonid migration, rearing, spawning, and harvesting.
2. Other fish migration, rearing, spawning, and harvesting.
3. Clam, oyster, and mussel rearing, spawning, and harvesting.
4. Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing, spawning, and harvesting.

D. Wildlife habitat.

E. Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment.

F. Commerce and navigation.

III. Water quality criteria.

A. **Fecal coliform organisms.**
1. Freshwater - fecal coliform organisms shall not exceed a geometric mean value of 100 organisms/100 mL, with not more than 10 percent of samples exceeding 200 organisms/100 mL.
2. Marine water - fecal coliform organisms shall not exceed a geometric mean value of 14 organisms/100 mL, with not more than 10 percent of samples exceeding 43 organisms/100 mL.

B. **Dissolved oxygen.**
1. Freshwater - dissolved oxygen shall exceed 8.0 mg/L.
2. Marine water - dissolved oxygen shall exceed 6.0 mg/L. When natural conditions, such as upwelling, occur, causing the dissolved oxygen to be depressed near or below 6.0 mg/L, natural dissolved oxygen levels can be degraded by up to 0.2 mg/L by man-caused activities.

C. **Total dissolved gas.**

Shall not exceed 110 percent of saturation at any point of sample collection.

Appendix D. Water Quality Standards for Class A Waters (continued).

D. **Temperature** shall not exceed 18°C (freshwater) or 16°C (marine water) due to human activities. Temperature increases shall not at any time, exceed $t=28/(T+7)$ (freshwater) or $t=12/(T-2)$ (marine water). When natural conditions exceed 18°C (freshwater) and 16°C (marine water), no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C. For purposes hereof, "t" represents the maximum permissible temperature increase measured at a dilution zone boundary; and "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge; provided that temperature increase resulting from nonpoint source activities shall not exceed 2.8°C, and the maximum water temperature shall not exceed 18.3°C (freshwater).

E. **pH** shall be within the range of 6.5 to 8.5 (freshwater) or 7.0 to 8.5 (marine water) with a man-caused variation within a range of less than 0.5 units.

F. **Turbidity** shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

G. **Toxic, radioactive, or deleterious material** concentrations shall be below those which may adversely affect characteristic water uses, cause acute or chronic conditions to the aquatic biota, or adversely affect public health (see WAC 173-201-047).

H. **Aesthetic values** shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.